

ENDOCRINE SYSTEM
PANCREAS.

As we know from the digestive system, the pancreas is a compound gland , has exocrine portion and endocrine portion . the exocrine portion related to pancreatic acini which secret digestive enzymes and small ductules secrets alkaline fluid , and these combined products pass through the pancreatic duct into the duodenum.

The endocrine portion is the island of langerhans which composed of three types of cells , Alpha cells , Beta cells and delta cells.

The beta cells present 60% from the total cells of island of langerhans.

Beta cells secret the insulin hormone and beta cells secret the glucagon hormones and delta cells secrete the somatostatin hormones.

Between meals the tissues cells use another substrate for energy , because between meals the lend of glucose is low , so the lend of insulin also will be low .

As a result the glucose cannot diffuse easily to these cells, for this reason the tissue cells use the fatty acids metabolism as a source of energy between meals.

After meals , the tissue cells use glucose as a source of energy . because after meals the glucose level is high , and insulin secretion will be increased , so glucose can diffuse to tissue cells easily.

Also during moderate or heavy exercises the tissue cells use glucose even without the presence of insulin in high level.

Tissue cells ((muscles and liver)) store the excessive glucose by converting it into glycogen .

After meals , the uptake of glucose by liver cells will increase , also in liver cells a stimulation of (glucokinase), enzyme will occur , this enzyme will phosphorlate the glucose , because when glucose get phosphorlated by this enzyme , it cannot diffuse from the cells to the blood.

Insulin also activate the ((glycogen synthase))

Enzyme , by which the excessive glucose is converted to glycogen.

Insulin also inhibits the liver ((phosphorylase)) enzyme .

The liver phosphorylase enzyme function is degradation of glycogen ((glycogenolysis))

Between meals the glucose level will be low , this decrease the insulin level.

As result the liver phosphorylase enzyme will be activated and cause degradation of glycogen to glucose phosphate.

Between meals most of body tissues use another source of energy such as , fatty acids-amino acids)). But brain cells use only glucose for metabolism , because brain cells use glucose without the need the need of insulin hormone.

((Insulin _ Independent)).

There are also another cells which are mostly use glucose such as ; Retina cells and germinal epithelium of reproductive glands (testis in male and ovary in female).Increase in glucose level activate the glycogenesesis process by which glucose will be converted into glycogen ,but when glucose is in highly excessive level ,it will be converted into fatty acids and liver cells convert the fatty acids to triglycerides and release them to the blood in the form of lipoprotein. Under the effect of insulin , an activation of lipoprotein lipase in the capillaries wall of the adipose tissues will occur.

The lipoprotein lipase enzyme breaks down the triglycerides into free fatty acids ,these free fatty acids will enter the adipose tissues and converted again into triglycerides in order to be stored .Insulin inhibits the adipose cells lipase .But in diabetic mellitus patients due to deficiency in insulin hormone ,the adipose cells lipase will be activated and will hydrolysis the triglycerides into free fatty acids which will be released to the blood . As consequence the level of free fatty acids in blood will be increase .

For this reason the fatty acids will become the main substrate of energy. In this case fatty acids will enter the liver cells and converted into triglycerides ,cholesterol and phospholipids and then released to the blood this will cause increase in lipid concentration in blood especially in cholesterol level , this explain why diabetic patients suffer from atherosclerosis .

Also in diabetics mellitus patients , an activations of transport mechanism of fatty acids to mitochondria occurs , in mitochondria occurs rapid oxidation of fatty acids and releasing of high amount of acetyl Co- A . Acetyl co-A will be condensed and converted to acetoacetate which in turn will be releases to the blood . The peripheral tissue cells can metabolize the acetoacetate and convert it to acetyl co – A to get energy (this occurs normally) ,but in case of diabetics mellitus the ability of peripheral tissue cells to metabolize acetoacetate is reduced , So acetoacetate will be accumulated. Small part of acetoacetate can be converted to

B-hydroxybutyric acid and acetone (keton bodies) . this cause (metabolic acidosis (ketosis)) in diabetics mellitus patients . Insulin increase the uptake of glucose by cells and stimulate fat synthesis , Normally Insulin increase the transport of amino acids into the cells and inhibits catabolism of proteins , but in diabetic mellitus catabolism of protein will be increase because the level of insulin is low and no inhibition occurs to protein catabolism . The main stimulation of insulin secretion is the presence of glucose , but they found that some amino acids also can increase the insulin secretion .

They make an experiment by giving a person only amino acids , and they notice slight increase in insulin secretion level , but when they give a person amino acids with glucose the insulin secretion is highly increased , so amino acids potentiate the insulin secretion ,((make it more high)) when it is administered with high glucose intake .So , it prefer to take proteins with glucose to potentiate the insulin secretion .

Table 78–1

Factors and Conditions That Increase or Decrease Insulin Secretion

Increase Insulin Secretion	Decrease Insulin Secretion
• Increased blood glucose • Increased blood free fatty acids • Increased blood amino acids • Gastrointestinal hormones (gastrin, cholecystokinin, secretin, gastric inhibitory peptide) • Glucagon, growth hormone, cortisol • Parasympathetic stimulation; acetylcholine • β-Adrenergic stimulation • Insulin resistance; obesity • Sulfonylurea drugs (glyburide, tolbutamide)	• Decreased blood glucose • Fasting • Somatostatin • α-Adrenergic activity • Leptin

Glucagon hormone

Glucagon is secreted by Alpha cells ; it is a hyperglycemic hormone because it increases the blood glucose level. The secretion of this hormone is stimulated by hypoglycemia .

Effects of glucagon hormone :

1-it breakdown of liver glycogen(glycogenolysis)by activation of the enzyme (liver phsphorylase)

2- activate gluconeogenesis process .

3- Activates the adipose tissue cells lipase to hydrolyze the triglycerides to fatty acids in order to increase quantities of fatty acids available to be the main substrate of the energy system of the body .

Diabetes mellitus :

There are two types : type one I (insulin dependent) diabetes , it usually occurs in children about 14 years old , for this reason is often called "Juvenile diabetes " , it is less common type and it also can occur in any age .

Causes of diabetes type one :

1-Viral infections.

2- Autoimmune disorders .

These two causes destruct the beta cells of pancreas .Patients of diabetes mellitus type one I must have heredity tendency to the destruction of beta cells by viral infections and autoimmune disorders . In some patients there may be heredity tendency for beta cells degradation even without the viral infections or autoimmune disorders .

Types two II (non insulin dependent) diabetes it is the most common type 90% . This type usually occurs after 30 years old , for this reason is often called (Adult or maturity onset diabetes mellitus).

Causes of diabetes type two:

1- Genetic factors

2- Obesity especially accumulation of abdominal fats .

Level of insulin may be normal or even raised , the problem is decrease the sensitivity of tissue cells to the insulin hormone effects , this state called insulin resistance .

They found that in obesity people who suffer from diabetes ,they have less receptors of insulin in their cells.

The normal fasting blood sugar is 75-110 .

Some clinical features of diabetes mellitus :

- Glycosuria ; glucose execration in urine "normally there is no glucose in urine" .
- Blood glucose level more than 180
- Polyuria ;reason of polyuria is the increased concentration of glucose in renal tubules this cause osmotic dieresis (large volume of urine)
- Polydepsia ;polyuria cause dehydration thus increase the extracellular fluid osmolarity especially in the concentration of Na ions ,this cause stimulation of thirst centre ,So person feel thirsty .
- Polyphagia ; stimulation of feeding or hunger centre ,because of low level of glucose in the cells , So patient eat more frequently .
- Decease resistance to bacterial infections

Table 78–3

Clinical Characteristics of Patients with Type I and Type II Diabetes Mellitus

Feature	Type I	Type II
Age at onset	Usually <20 years	Usually >30 years
Body mass	Low (wasted) to normal	Obese
Plasma insulin	Low or absent	Normal to high initially
Plasma glucagon	High, can be suppressed	High, resistant to suppression
Plasma glucose	Increased	Increased
Insulin sensitivity	Normal	Reduced
Therapy	Insulin	Weight loss, thiazolidinediones, metformin, sulfonylureas, insulin